

TEACHER FOR A DAY

Suggested Grade

6

SD Mathematics Strand & Standard (*Primary for Task*)

Algebra

6.A.1.1. Students are able to use order of operations, excluding nested parentheses and exponents, to simplify whole number expressions.

Task Summary

Students will use knowledge of the correct order of operations to identify and correct computation errors.

Time and Context of Task

This task would be done at the end of a unit on order of operations. It should take three class periods. Students would complete the answer key and then correct the student's paper on the first day. On the second day students would discuss answers and prepare the reports. On the last day students would share their reports with the class.

Materials Needed

Directions page; Worksheets 1, 2, and 3; Copies of Students A, B, and C's completed worksheets for Worksheets 1, 2, and 3; (Each sample worksheet will have different mistakes.)

Author and Lead Teacher for This Task

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TEACHER FOR A DAY

Students will be working in groups of three people. Each student in a group will be given the same worksheet and told to individually make an answer key. Students should then compare their answers to be sure their “Answer Keys” are correct. Each student will then be given a sample student’s paper. (There are three different sample students so each sample student’s paper will have different mistakes on it.) Students will “grade” the paper and figure out what mistakes were made. When this is done, students will get together in their group to compare the types of mistakes the sample students made. As a group, they will prepare a report to the whole class describing common types of mistakes. The report should also include suggestions of what they would do as a teacher to help students avoid those common mistakes. (Since there are only three sets of worksheets, some of the groups will receive the same worksheets.)



Teacher for a Day Order of Operations

Directions: You will be working in groups of three people.

- 1) As a group, pick Worksheet 1, 2, or 3. Each student in your group will individually make an answer key for that worksheet.
- 2) Now compare your answers to be sure your “Answer Keys” are correct.
- 3) Get Student A, B, and C’s papers for your worksheet. Each person in your group will correct a different student’s paper. Pay close attention to the types of mistakes they are making.
- 4) As a group, discuss the mistakes the sample students made. Then prepare a report to the whole class describing common types of mistakes. Your report should also include suggestions of what you would do as teachers to help students avoid these common mistakes.



Teacher for a Day
Order of Operations #1

Directions: Use order of operations to simplify the numerical expressions.

Order of Operations: First do the operation(s) in parentheses.
Next multiply and divide from left to right.
Then add and subtract from left to right.

$$(5 + 7) / 2$$

$$3 + 4 \times 2$$

$$(3 + 4) \times 2$$

$$(6-2) \times (7-3)$$

$$8 - 2 \times (7-5)$$

$$15 / (8 - 3) + 6$$

$$4 + 22 / 11$$

$$6 \times (3 + 2)$$

$$15 - 2 \times 3$$

$$6 + 3 \times (8 / 2)$$

$$50 / (2 + 3) - 7$$

$$5 \times 3 + (8 - 2)$$

$$15 + 15 - (3 + 2)$$

$$15 + 3 - 9 \times 2$$

$$6 + 6 / 2$$

$$3 \times 2 + 4 \times 3$$

$$3 \times (2 + 4) \times 3$$

$$7 - 7 + 3 \times 3 - 5$$

$$2 \times 5 - (7 - 2) + 3$$

$$(8 - 3) \times 7$$

$$8 + 3 \times 7$$

Teacher for a Day
Order of Operations #2

Directions: Use order of operations to simplify the numerical expressions.

Order of Operations: First do the operation(s) in parentheses.
Next multiply and divide from left to right.
Then add and subtract from left to right.

$$(20 - 6) \times 2$$

$$20 - 6 \times 2$$

$$12 + 18 / 6$$

$$(54 / 9) - (2 + 3)$$

$$12 - 2 \times (3 + 3)$$

$$7 \times (4 - 2)$$

$$3 + 50 / 5$$

$$2 \times (5 + 4)$$

$$25 - 4 \times 3$$

$$30 - 16 + 10$$

$$6 \times 5 - 2 \times 3$$

$$7 \times 4 - 2 / 1$$

$$4 + 5 \times (7 - 5)$$

$$27 / 3 - 3 \times 2$$

$$1 + (3 - 3) \times 8$$

$$66 / (3 \times 2) - 3$$

$$16 + 12 - 8 / 2$$

$$8 + 3 \times 4$$

$$5 \times 16 / 4 + 4$$

$$19 - 8 + 5$$

$$8 - 8 / 2 + 3 \times 4$$

Teacher for a Day
Order of Operations #3

Directions: Use order of operations to simplify the numerical expressions.

Order of Operations: First do the operation(s) in parentheses.
Next multiply and divide from left to right.
Then add and subtract from left to right.

$$20 - 13 + 2$$

$$4 \times 4 + 3 \times 2$$

$$4 \times (4 + 3) \times 2$$

$$5 + 4 \times 3 + 2$$

$$6 \times (8 + 3)$$

$$8 - 2 \times 4 + 1$$

$$6 + 2 \times 5$$

$$20 - 1 + (5 \times 2)$$

$$24 - (6 + 2)$$

$$30 - 6 \times 3$$

$$2 \times 8 + 12 - 4$$

$$30 - 6 + 5$$

$$21 - 6 \times 3$$

$$2 \times (6 + 4) - 3$$

$$8 - (3 \times 2) + 2$$

$$5 + 6 \times 4 - 3$$

$$(5 + 6) \times 4 - 3$$

$$5 + 6 \times (4 - 3)$$

$$(6 + 2) \times 4$$

$$20 - 8 / 2$$

$$4 \times 8 - 2 \times 9$$

CONTENT STANDARDS

Primary Standard

Strand Name: Algebra

SD Goal: Students will use the language of algebra to explore, describe, represent, and analyze number expressions and relations that represent variable quantities.

Indicator: Use procedures to transform algebraic expressions.

Standard: 6.A.1.1. Students are able to use order of operations, excluding nested parentheses and exponents, to simplify whole number expressions.

NCTM Process Standard

Communication: Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.

Communication: Analyze and evaluate the mathematical thinking and strategies of others.

Problem-Solving Strategies

- Estimation and check
- Elimination of extraneous data
- Acting out the problem
- Looking for patterns

ASSESSMENT TOOLS

Task Rubric

| | Advanced | Proficient | Basic | Below Basic |
|--|---|---|--|---|
| Content Standard: 6.A.1.1. Students are able to use order of operations, excluding nested parentheses and exponents, to simplify whole number expressions. | Correct use of order of operations to complete answer key. | Correct use of order of operations with only a few calculation errors. | Several mistakes in the use of order of operations. | Incorrect use of order of operations. |
| NCTM Process Standard: Communication: Analyze and evaluate the mathematical thinking and strategies of others. | Accurately identifies sample student's errors, describes common types of errors and makes one or more suggestions on how to help students avoid these errors. | Identifies sample student's errors and describes some common types of errors. | Identifies some sample student's mistakes and describes only one type of errors. | Identifies some of sample student's mistakes and is unable to find and describe common types of errors. |

Sixth Grade Algebra Performance Descriptors

| | |
|-------------------|--|
| Advanced | Sixth grade students performing at the advanced level: <ul style="list-style-type: none"> • write and simplify 1st degree algebraic expressions, and solve 1st degree algebraic equations, using the set of whole numbers, and justify solution(s); • apply unit rates. |
| Proficient | Sixth grade students performing at the proficient level: <ul style="list-style-type: none"> • write and simplify 1st degree algebraic expressions, and solve 1st degree algebraic equations, using the set of whole numbers; • find unit rate; • identify and graph ordered pairs in Quadrant I on a coordinate plane. |
| Basic | Sixth grade students performing at the basic level: <ul style="list-style-type: none"> • simplify 1st degree algebraic expressions, and solve 1st degree equations, using the set of whole numbers. |

Sixth Grade Algebra ELL Performance Descriptors

| | |
|---------------------|---|
| Proficient | Sixth grade ELL students performing at the proficient level: <ul style="list-style-type: none"> • evaluate numerical expressions using the order of operations; • write algebraic expressions; • solve one-step algebraic equations with a replacement set; • graph ordered pairs in Quadrant I; • read, write, and speak the basic language of algebra. |
| Intermediate | Sixth grade ELL students performing at the intermediate level: <ul style="list-style-type: none"> • evaluate numerical expressions given the order of operations; • simplify algebraic expressions with a given value; • create numerical expressions from oral or written contexts; • explain in mathematical terms the sequence of steps used in solving problems; • give simple oral responses to directed questions on topics presented in class. |
| Basic | Sixth grade ELL students performing at the basic level: <ul style="list-style-type: none"> • add, subtract, multiply, and divide whole numbers; • recognize and use basic algebraic terms; • respond to yes or no questions and to problems presented pictorially or numerically in class. |
| Emergent | Sixth grade ELL students performing at the emergent level: <ul style="list-style-type: none"> • solve numerical (not word) problems using addition, subtraction, multiplication, and division; • copy and write numerals and algebraic symbols; • imitate pronunciation of numbers and mathematical terms; • use non-verbal communication to express mathematical ideas. |
| Pre-emergent | Sixth grade ELL students performing at the pre-emergent level: <ul style="list-style-type: none"> • observe and model appropriate cultural and learning behaviors from peers and adults; • listen to and observe comprehensible instruction and communicate understanding non-verbally. |

TEACHER FOR A DAY

Student Work Samples



As you examine the samples, consider the following questions:

- In light of the standard/s addressed and the assessment tools provided, what evidence does the work provide that students are achieving proficiency in the knowledge and skills addressed by the standard/s for the task?
- Is the task/activity well designed to help students acquire knowledge and demonstrate proficiency? Is the task/activity clearly aligned with the standards? In what ways would you adapt the task/activity to better meet the needs of your students?

Teacher for a Day – Order of Operations #3

Directions: Use order of operations to simplify the numerical expressions.

Order of Operations:

First do the operation(s) in parentheses.
Next multiply and divide from left to right.
Then add and subtract from left to right.

$$\begin{aligned} & 20 - 13 + 2 \\ & = 20 - 15 \\ & = \boxed{5} \end{aligned}$$

7 + 2
left to right

$$\begin{aligned} & 4 \times 4 + 3 \times 2 \\ & = 16 + 6 \\ & = \boxed{22} \end{aligned}$$

missed step

$$\begin{aligned} & 4 \times (4 + 3) \times 2 \\ & = 4 \times 7 \times 2 \\ & = 28 \times 2 \\ & = \boxed{30} \end{aligned}$$

times not plus!!!

$$\begin{aligned} & * \text{SUPER} \\ & 5 + 4 \times 3 + 2 \\ & = 5 + 12 + 2 \\ & = 17 + 2 \\ & = \boxed{19} \end{aligned}$$

$$\begin{aligned} & * \text{SUPER} \\ & 6 \times (8 + 3) \\ & = 6 \times 11 \\ & = \boxed{66} \end{aligned}$$

$$\begin{aligned} & 8 - 2 \times 4 + 1 \\ & = 6 \times 4 + 1 \\ & = 24 + 1 \\ & = \boxed{25} \end{aligned}$$

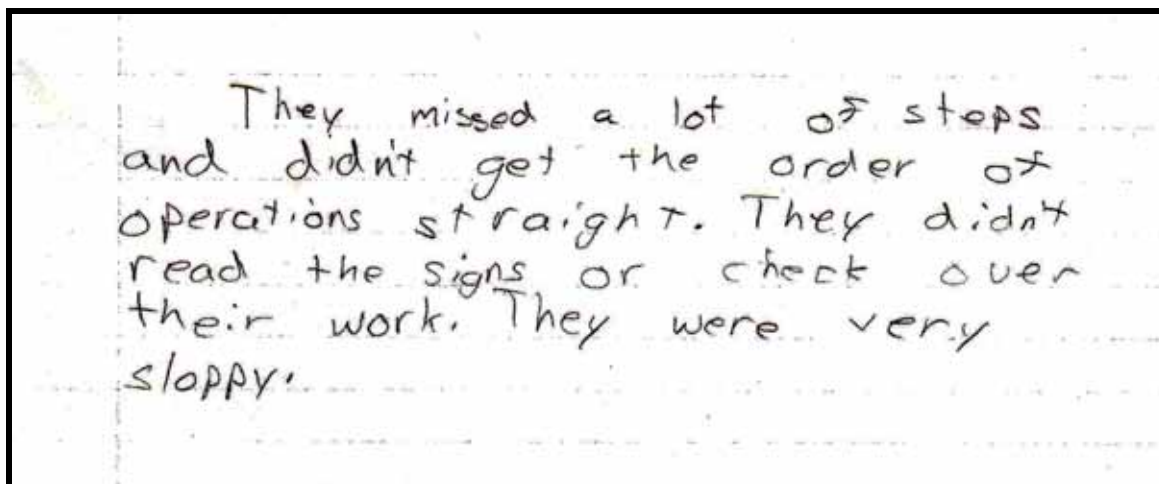
multiply before adding & subtracting
= 8 + 8 + 1 = 17

$$\begin{aligned} & * \text{Super} \\ & 6 + 2 \times 5 \\ & = 6 + 10 \\ & = \boxed{16} \end{aligned}$$

$$\begin{aligned} & * \text{Super} \\ & 20 - 1 + (5 \times 2) \\ & = 20 - 1 + 10 \\ & = 19 + 10 \\ & = \boxed{29} \end{aligned}$$

$$\begin{aligned} & * \text{Super} \\ & 24 - (6 + 2) \\ & = 24 - 8 \\ & = \boxed{16} \end{aligned}$$

| | | |
|---|---|---|
| 6×3 $= 30 - 18$ $= \boxed{12}$ | $2 \times 8 + 12 - 4$ missed step missed step $= 16 + 8$ $= \boxed{24}$ | Smart $30 - 6 + 5$ $= 24 + 5$ $= \boxed{29}$ |
| $21 - 6 \times 3$ $= 15 \times 3$ $= \boxed{45}$ <i>times before</i> | Superb $2 \times (6 + 4) - 3$ $= 2 \times 10 - 3$ $= 20 - 3$ $= \boxed{17}$ | $8 - (3 \times 2) + 2$ $= 8 - 6 + 2$ $= 2 + 2$ $= \boxed{5}$ missed step $3 \times 2 = 6$ |
| $5 + 6 \times 4 - 3$ missed steps missed steps $= 11 \times 3$ $= \boxed{11}$ missed step | Superb $(5 + 6) \times 4 - 3$ $= 11 \times 4 - 3$ $= 44 - 3$ $= \boxed{41}$ | $5 + 6 \times (4 - 3)$ missed steps missed steps $= 11 \times 1$ $= \boxed{11}$ |
| $(6 + 2) \times 4$ $= 8 \times 4$ $= \boxed{16}$ not x | $20 - 8 \div 2$ $= 12 \div 2$ $= \boxed{6}$ before - | $4 \times 8 - 2 \times 9$ missed step missed step $= 32 - 18$ $= \boxed{14}$ |



Looking at Student Work – Instructor notes and rating for work sample #1:

(Since I allowed students to check their answer keys with their group members, all of the groups had accurate answer keys, which gives them an “Advanced” score on Content Standard 6.A.1.1. Next year I will individually check answer keys before letting students compare within their group. That way I’ll know if each individual student can use order of operations correctly. In the interest of space, I’ve only copied one of the sample students’ papers that has been corrected by the group. Each group would have had three of these sample students’ papers. The other two samples were similar to the one I copied.)

This group wrote a short, general paragraph about the sample students’ papers, which makes it seem like they weren’t sure what mistakes the students made. However when you examine the graded samples, you can see that each type of mistake that the sample student made. They received a score of “Advanced” on Content Standard 6.A.1.1 and a score of “Proficient” on NCTM Process Standard, Communication.

Teacher for a Day – Order of Operations #3

Directions: Use order of operations to simplify the numerical expressions.

Order of Operations:

First do the operation(s) in parentheses.
Next multiply and divide from left to right.
Then add and subtract from left to right.

**Good*

$$20 - 13 + 2$$

$$= 7 + 2$$

$$= \boxed{9}$$

$$4 \times 4 + 3 \times 2$$

$$= 16 + 3 \times 2$$

$$= 16 + 6$$

$$= \boxed{22}$$

**Great*

$$4 \times (4 + 3) \times 2$$

$$= 4 \times 7 \times 2$$

$$= 28 \times 2$$

$$= \boxed{56}$$

$$5 + 4 \times 3 + 2$$

$$= 5 + 12 + 2$$

$$= \boxed{19}$$

**Super*

$$6 \times (8 + 3)$$

$$= 6 \times 11$$

$$= \boxed{66}$$

**Amazing*

$$8 - 2 \times 4 - 1$$

$$= 8 - 8 - 1$$

$$= -1$$

$$6 + 2 \times 5$$

$$= 6 + 10$$

$$= \boxed{16}$$

$$20 - 1 + (5 \times 2)$$

$$= 20 - 1 + 10$$

$$= 19 + 10$$

$$= \boxed{29}$$

not x

$$24 - (6 + 2)$$

$$= 24 - 8$$

$$= \boxed{16}$$

Right
 $30 - 6 \times 3$
 $= 30 - 18$
 $= 12$

left to right
 $2 \times 8 + 12 - 4$
 $= 16 + 12 - 4$
 $= 16 + 8$
 $= 24$

Sup
 $30 - 6 + 5$
 $= 24 + 5$
 $= 29$

Super
 $21 - 6 \times 3$
 $= 21 - 18$
 $= 3$

before
 $2 \times (6 + 4) - 3$
 $= 2 \times 10 - 3$
 $= 2 \times 7$
 $= 14$

Super
 $8 - (3 \times 2) + 2$
 $= 8 - 6 + 2$
 $= 2 + 2$
 $= 4$

before +
 $5 + 6 \times 4 - 3$
 $= 11 \times 4 - 3$
 $= 44 - 3$
 $= 41$

Super
 $(5 + 6) \times 4 - 3$
 $= 11 \times 4 - 3$
 $= 44 - 3$
 $= 41$

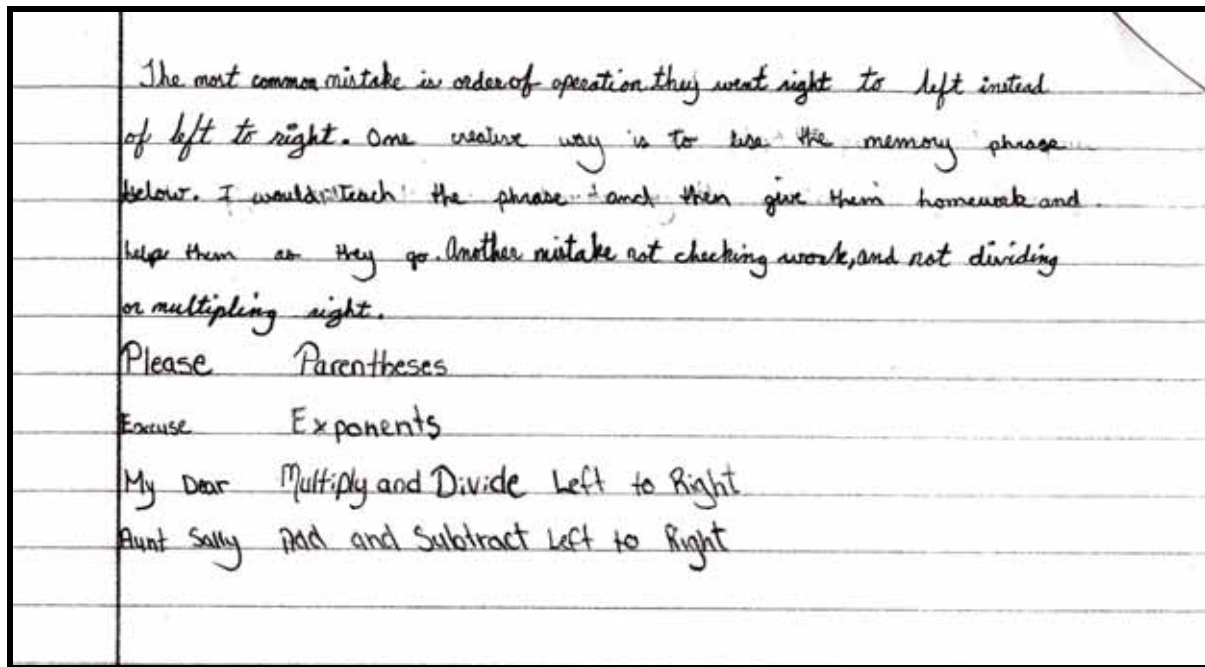
before +
 $5 + 6 \times (4 - 3)$
 $= 5 + 6 \times 1$
 $= 11 \times 1$
 $= 11$

not X
 $(6 + 2) \times 4$
 $= 12 \times 4$
 $= 48$

Super
 $20 - 8 / 2$
 $= 20 - 4$
 $= 16$

before -
 $4 \times 8 - 2 \times 9$
 $= 32 - 2 \times 9$
 $= 30 \times 9$
 $= 270$

Sample #2 – page 3



Looking at Student Work – Instructor notes and rating for work sample #2:

(Since I allowed students to check their answer keys with their group members, all of the groups had accurate answer keys, which gives them an “Advanced” score on Content Standard 6.A.1.1. Next year I will individually check answer keys before letting students compare within their group. That way I’ll know if each individual student can use order of operations correctly. In the interest of space, I’ve only copied one of the sample students’ papers that has been corrected by the group. Each group would have had three of these sample students’ papers. The other two samples were similar to the one I copied.)

This group also labeled the types of mistakes as they graded the sample papers. They did a better job than group 1 with their written explanation. They identified three types of mistakes and made one suggestion on how students can remember order of operations. They received a score of “Advanced” on Content Standard 6.A.1.1 and a score of “Advanced” on NCTM Process Standard, Communication.

Student Work Sample #3

Teacher for a Day – Order of Operations #1

Directions: Use order of operations to simplify the numerical expressions.

Order of Operations:

First do the operation(s) in parentheses.
Next multiply and divide from left to right.
Then add and subtract from left to right.

$$\times (5 + 7) / 2$$

$$= 12 \div 2$$

$$= \boxed{6}$$

$$3 + 4 \times 2$$

$$= 7 \times 2$$

$$= \boxed{14}$$

$$\times (3 + 4) \times 2$$

$$= 7 \times 2$$

$$= \boxed{14}$$

missing step -1

$$(6 - 2) \times (7 - 3)$$

$$= 4 \times 4$$

$$= \boxed{16}$$

missing step -1

$$8 - 2 \times (7 - 5)$$

$$= 6 \times 2$$

$$= \boxed{12}$$

$$\times 15 / (8 - 3) + 6$$

$$= 15 \div 5 + 6$$

$$= 3 + 6$$

$$= \boxed{9}$$

$$4 + 22 / 11$$

$$= 4 + 2$$

$$= \boxed{8}$$

$$6 \times (3 + 2)$$

$$= 18 + 2$$

$$= \boxed{20}$$

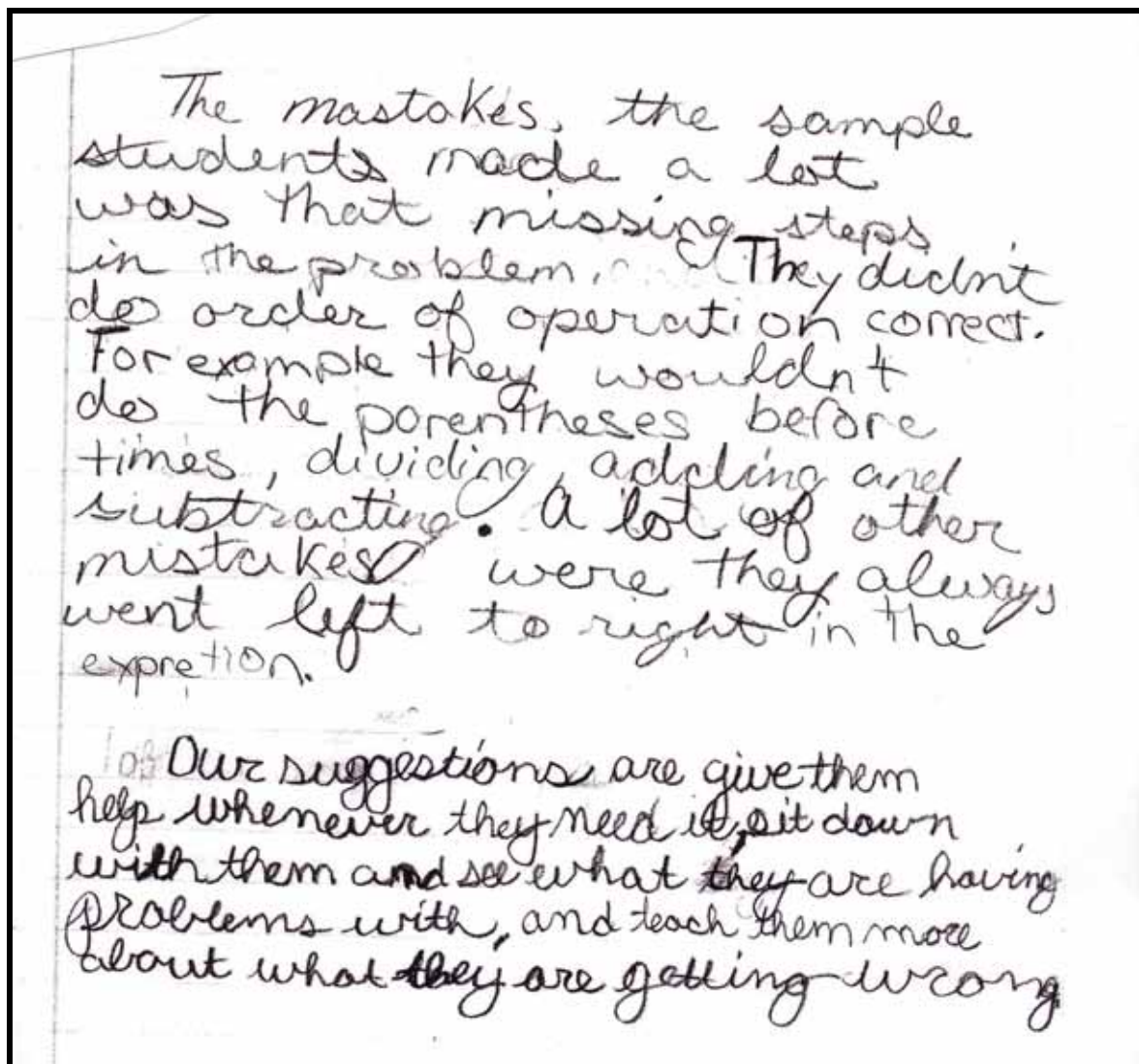
$$15 - 2 \times 3$$

$$= 13 \times 3$$

$$= \boxed{39}$$

| | | |
|---|---|---|
| $6 + 3 \times (8 / 2)$ $= 6 + 3 \times 4$ $= 6 + 12$ $= \boxed{20}$ | $50 / (2 + 3) - 7$ $= 25 + 3 - 7$ $= 28 - 7$ $= \boxed{21}$ | $5 \times 3 + (8 - 2)$ $= 15 + 4$ $= \boxed{19}$ |
| $15 + 15 - (3 + 2)$ $= 15 + 15 - 6$ $= 30 - 6$ $= \boxed{24}$ | $15 + 3 - 9 \times 2$ $= 15 + 3 - 18$ $= 18 - 18$ $= \boxed{0}$ | $6 + 6 / 2$ $= 6 + 3$ $= \boxed{9}$ |
| $3 \times 2 + 4 \times 3$ $= 3 \times 6 \times 3$ $= 18 \times 3$ $= \boxed{54}$ | $3 \times (2 + 4) \times 3$ $= 3 \times 6 \times 3$ $= 18 \times 3$ $= \boxed{54}$ | $7 - 7 + 3 \times 3 - 5$ $= 7 - 7 + 9 - 5$ $= 7 - 16 - 5$ $= 9 - 5$ $= \boxed{4}$ |
| $2 \times 5 - (7 - 2) + 3$ $= 10 - 5 + 3$ $= 2 + 3$ $= \boxed{5}$ | $(8 - 3) \times 7$ $= 4 \times 7$ $= \boxed{28}$ | $8 + 3 \times 7$ $= 11 \times 7$ $= \boxed{77}$ |

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Looking at Student Work – Instructor notes and rating for work sample #3:

(Since I allowed students to check their answer keys with their group members, all of the groups had accurate answer keys, which gives them an “Advanced” score on Content Standard 6.A.1.1. Next year I will individually check answer keys before letting students compare within their group. That way I’ll know if each individual student can use order of operations correctly. In the interest of space, I’ve only copied one of the sample students’ papers that have been corrected by the group. Each group would have had three of these sample students’ papers. The other two samples were similar to the one I copied.)

This group also labeled the types of mistakes on the sample students’ papers. They identified three types of mistakes and gave details about them. Their suggestions for helping students were too general and could be used in any class with any assignment. They received a score of “Advanced” on Content Standard 6.A.1.1 and a score of “Proficient” on NCTM Process Standard, Communication.

INSTRUCTIONAL NOTES

I had a difficult time finding a real-world use of order of operations. However, I have noticed that many students enjoy helping others and might want to become teachers themselves. By having them make an answer key, I could determine whether they were able to use order of operations correctly. I had also hoped that by having students write how they would help the sample students correct their mistakes, I would get some new ideas on how to help students with order of operations. I was disappointed because their suggestions just mimicked what I had already used – I didn't get any original ideas.

This type of task can be used with many mathematical topics. Students enjoy being the teacher and finding and analyzing other's errors.

Students used order of operations to complete their answer keys. When comparing their work with their groups, they often caught any mistakes they made. As they graded the sample students' work, many students listed the error, or wrote in the correct answer. This made it easier to write their reports.

Some students still had trouble making their answer keys, making some of the types of mistakes on the samples students' papers. However, by checking their answer keys with their classmates, they were able to correct their mistakes before checking the sample students' papers.

Resources

SD Mathematics Content Standards

<http://www.doe.sd.gov/contentstandards/math/index.asp>

SD Assessment and Testing

<http://www.doe.sd.gov/octa/assessment/index.asp>

The National Assessment of Educational Progress (NAEP)

<http://www.doe.sd.gov/octa/assessment/naep/index.asp>

National Council of Teachers of Mathematics

<http://nctm.org/>

Looking at Student Work

<http://www.lasw.org/index.html>